Climate Change-Responsive Integrated River Basin Management and Development Master Plans for the 8 Clustered River Basins

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Executive Summary of Cluster 2

(Malaking Ilog and Iyam-Dumacaa)

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Table of Contents

1 Rationale 1

2 Project Objectives 1

3 Scope and Limitation 1

4 Methodology 2

5 Assessment Reports 3

5.1 Geophysical Profile 3

5.1.1 Geographic Location 3

5.1.2 Climate Trends 3

5.1.3 Topography 4

5.1.4 Soils and Geology 4

5.1.5 Water Resources 4

5.1.6 Land Classification and Land Cover 4

5.1.7 Natural Hazards 5

5.2 Bioecological Profile 6

5.3 Demographic Profile 6

5.4 Socio-economic Profile 7

5.1.8 Settlement Pattern 7

5.1.9 House Tenure 7

5.1.10 Energy Consumption 7

5.1.11 Health 7

5.1.12 Literacy and Education 7

5.1.13 Poverty and Subsidence 7

5.1.14 Human Development Index 7

5.1.15 Employment and Labor 7

5.1.16 Natural Resource Dependent Livelihood 8

5.5 Infrastructure 8

5.1.17 Educational Facilities 8

5.1.18 Health Facilities 8

5.1.19 Evacuation Centers 8

5.1.20 Road and Bridges 8

5.1.21 Water Supply 8

5.1.22 Dam and Irrigation 9

5.1.23 Waste and Sanitation 9

5.6 Stakeholder Analysis 9

5.7 Land Capability 9

5.8 Policy and Institutional Assessment 10

5.9 Sensitivity and Exposure Analysis 10

5.9.1 Landslide 10
5.9.2 Water Resources 11
5.9.3 Participatory Risk and Vulnerability Assessment 11
6 Implementation Plan 12
6.1 Vision 12
6.2 Mission 12
6.3 Development Issues and Challenges 12
6.4.1 Selection of Key Indicators 13
6.4.2 Defining Future Scenarios 13
6.4.3 Estimation of Reference Case Values of the Key Indicators 13
6.4.4 Identification and Selection of Preferred Measures and PAPs 14
6.4.5 Identified Programs and Projects 14
7 Investment Plan 15

1 Rationale

The River Basin Control Office (RBCO) is mandated through Executive Order Nos. 510, 816, and 50 to create and develop master plans for the country's river basins to solve environmental problems such as flooding and to provide sustainable water supply for the entire country.

Since 2007, there are already existing master plans for 18 major river basins in the Philippines pursuant to Executive Order No. 510. These 18 river basins were identified in accordance to the Climate Change Adaptation and Mitigation (CCAM) Cluster's Program Budget and Approach (PBA) in CY 2013 and CY 2015. The PBA also provided opportunities to expand to cover other river basins outside these 18 major river basins. The identified river basins were selected based on the following criteria: (a) absence of Integrated River Basin Management and Development Master Plans (IRBMDMP) and appropriate institutional mechanisms; (b) environmental problems such as flooding, landslides, deforestation, and water quality degradation are present in the area; (c) high poverty incidence; and (d) contributes to high economic growth of the country.

2 Project Objectives

The objective of this project is to formulate an Integrated River Basin Management and Development Master Plan (IRBMDMP) for the eight (8) Clusters of Watersheds and River Basins taking into consideration biological diversity and their capacity to provide ecosystem goods and services. The plan incorporates the implications of the new climate normal in addressing the concerns of the river basin on the following critical areas of concern:

a. Water resources management;
b. Forest Ecosystem and Biodiversity management;
c. Flood control/mitigation, disaster risk reduction and hazards management;
d. Wetland management (to include rivers, river deltas, marshlands, and coastal areas);
e. Economic development; and
f. Institutional linkages and organizational structure for river basin management.

3 Scope and Limitation

The project formulated the Integrated Management and Development Master Plan of the Cluster 2 River Basin consisting the two (2) principal river basins namely Malaking Ilog and Iyam-Dumacaa. It took into consideration potential climate change impacts to provide a sound basis for management decisions in the sustainable management of the resources therein. The project consisted of three phases, the scope of which includes:

1. Profiling of the river basin and vulnerability assessment;
2. Formulation vision, missions, and goals;
3. Identification of strategies, programs and projects;
4. Evaluation of strategies, programs and projects; and
5. Investment and implementation planning

4 Methodology

The project adopted the following methods and approaches to accomplish the objectives (Figure 1). The following tasks were undertaken during the implementation of the project

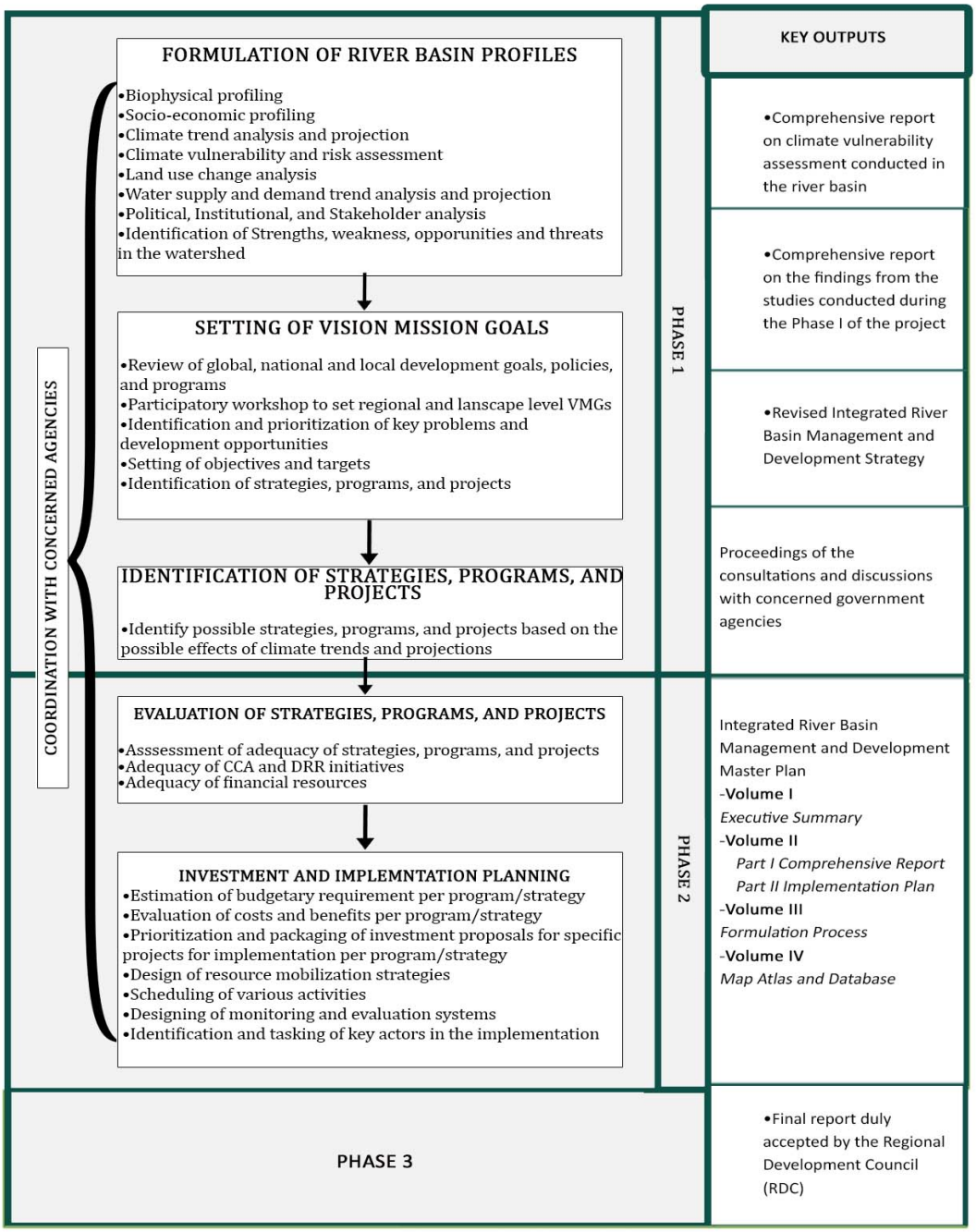

Figure 1. Framework for developing climate change-responsive integrated management and development master plan

5 Assessment Reports

This report is organized to have the following chapters related to Assessment. This focuses on the background information of the Project Area, Objectives of the Project, Methodology Adopted, Analysis Made and Strategies Proposed. The project mainly relied upon available secondary data, studies, information from various sources in the preparation of the assessment report. Analysis were made by respective experts based on these available data and information. Furthermore, the report was presented based on different thematic areas as affected by extreme climate events namely: 1) Water Resources, 2) Forest and Biodiversity Resources, 3) Wetland Resources, and 4) Economic.

Specifically, the watersheds in cluster 2 were characterized in terms of the following Profiles: Geophysical, Bioecological, Demographic, Socio-economic, Infrastructure, Stakeholder, Land Capabilities, and Vulnerability Assessments.

5.1 Geophysical Profile

5.1.1 Geographic Location

The River Basin is located along the southern part of Luzon, specifically within the provinces of Quezon, Laguna and Batangas of Region IV-A (CALABARZON), and drains into Tayabas Bay. It lies between the coordinates of 121° 8' 11.24" to 121° 35' 19.77" east longitude and 13° 44' 53.06" to 14° 4' 6.51" north latitude. It covers a total of four (4) cities, eighteen (18) municipalities and 662 barangays and an area of about 160, 926 hectares. It has two principal river basins and ten minor watersheds.

5.1.2 Climate Trends

The Cluster falls under the Types I, II and III of the Modified Corona Climate Classification System. Type I is described as having two pronounced seasons, which is typically dry from November to April and wet during the rest of the year, with the months of June to September generally receiving the most amount of rainfall. Type II climate is described as having no dry season with very pronounced maximum rainfall and wet season from the months of November to February while Type III climate has a short dry season from the months of February to April and a wet season for the rest of the year.

The province of Laguna experiences relatively dry weather from November to April and wet during the rest of the year, specifically in the small portion near the southern boundary while the eastern and southern portions of the province have no distinct season but with evenly distributed rainfall throughout the year. On the other hand, Batangas has two (2) distinct which is dry from November to April and wet during the rest of the year. On the other hand, for the province of Quezon, there are three (3) climatic types, which are: no dry season with very pronounced rainfall from November to January and wet during the rest of the year; not very pronounced season and relatively dry from November to April and wet during the rest of the year; and more or less evenly distributed rainfall throughout the year.

The mean annual temperature is around 28.3 ˚C to 29.2 ˚C, with January reaching 21.9 ˚C to 22.1 ˚C and May 32.4 ˚C to 33.9 °C. By 2050, rainfall is projected to increase by as much as 300 mm; seasonally, it is expected to decrease by 15% during the summer months and increase by 40% at the peak of the rainy season. For the provinces in the

cluster, the projected change in temperature is to increase by 2.5 ˚C by 2050, while the number of days with extremely high temperatures (>35 ˚C) is projected to increase two-fold, while the number of days with extremely high rainfall (>300 mm) is also projected to increase in 2050. On the other hand, rainfall is projected to increase by 0.4% to 23.2% during the wetter quarter of the year, while during the driest months there is a projected rainfall change of -6.8% to 0.4% across the three provinces by 2050 and 2085.

5.1.3 Topography

Majority of the cluster (51%) is found in relatively low elevations (0 – 100 meters above sea level), including parts of Batangas and Quezon. Its slope distribution is mostly composed of 0-3% slope or flat areas (45%) to 3-8% or moderately flat (21%) areas while only 6% is classified above 50% slope.

5.1.4 Soils and Geology

In terms of soil, there are eighteen (18) soil types from fourteen (14) different soil series, with soil textures ranging from coarse to fine. The largest soil type is the Lipa loam (22%) followed by the Guadalupe clay loam (21%). For the geological complexity, majority of the cluster is composed of volcanic plain or piedmont deposits bought about by its location near the Macolod Corridor and various active and inactive volcanoes.

Moreover, found in the cluster are three (3) operating mining tenements which mainly extracts non-metallic minerals such as sulfur and limestone or lime. These extracted non-metallic minerals are mainly used as fertilizers minerals and industrial and manufacturing materials.

5.1.5 Water Resources

The cluster is abundant with surface and ground water resources, with multiple rivers, lakes and springs located within the cluster. These water resources are three (3) main rivers namely Malaking Ilog, Iyam and Dumacaa Rivers, five (5) lakes - Bunot, Dagat- dagatan, Sampaloc, Pagatan and Ticub Lakes, and various springs. However, as December 2018 the national water board, estimated that the estimated available water in Region IV-A was around 8, 382 million cubic meters (MCM) with a water demand estimated at 16, 162 MCM and an estimated water potential of 7, 780 MCM. The water sourced for Region IV-A is usually sourced from groundwater (18%) and surface waters (82%).

The results of the simulated water balance of the cluster indicates that the domestic, municipal and industrial water demands in the region far exceeds the estimated available groundwater supply domestic in the watershed cluster with an estimated 873.15 MCM/yr deficit by 2030 and an estimated 165.36 MCM/yr deficit by 2050. There are 530 abstraction permits as of January 2019 that were granted by the NWRB in the cluster.

5.1.6 Land Classification and Land Cover

Most of the cluster is classified as alienable and disposable (87%) while only 13% are classified as forest lands. As of 2015, the dominant land cover observed in cluster are perennial (88, 333 ha or 55%) and annual (34, 575 ha or 21%) crops, followed by built-up areas (13, 266 ha or 8%). Land cover change analysis from 2003 to 2015 indicated that there was an increase in urbanization and a shift of farming preference to perennial crops. There was a jump from 35% to 55% (55, 853 ha to 88, 333 ha) for

perennial crops in the last twelve years while a decrease from 34% to 21% (54, 654 ha to 34, 575 ha) for annual crops. Built-up areas, on the other hand, had an increased from 1% to 8% (2, 399 ha to 13, 266 ha) from 2003 to 2015.

5.1.7 Natural Hazards

Several natural hazards are inherently present in the cluster namely: flooding, soil erosion, landslide, liquefaction, tropical cyclones, storm surges, tsunami, lahar and pyroclastic flow. The cluster is most affected by landslides and tropical cyclones or typhoons.

For the cluster, about 1, 036 ha are susceptible to flooding with very high to high susceptibility while majority of the areas are not susceptible to flooding (136, 983 ha). The municipalities/or cities most susceptible to flooding are San Juan, Batangas (1, 822 ha), San Pablo City, Laguna (1, 932 ha), Lucena City (680 ha) and Pagbilao (620 ha) in Quezon Province.

In terms of soil erosion, around 2, 434 ha experiences severe soil erosion while majority of the area recorded no apparent soil erosion (94, 725 ha). The municipality with the largest area with severe soil erosion is San Juan, Batangas with 1, 208 ha followed by San Pablo City, Laguna with 669 ha. In the province of Quezon, the municipality of Pagbilao has an area 291 ha that has severe soil erosion.

Approximately 28, 380 ha has a very high to high landslide susceptibility while 87, 283 ha has low susceptibility to landslides. Pagbilao has the largest area with high susceptibility category with approximately 5, 632 ha followed by the Tayabas City with 3, 264 ha.

Approximately 11, 409 hectares are affected with liquefaction. The municipalities of San Juan (4, 822 ha) and Sariaya (1, 796 ha) are the most affected.

The provinces of Quezon, Laguna and Batangas are prone to tropical cyclones and have a high tropical cyclone density. From 1948 – 2017, a total of 158 tropical cyclones have crossed the provinces of Quezon, Laguna and Batangas with majority of tropical cyclones classified as typhoons and an average of 15 -17 typhoons per year

Only parts of San Juan, Batangas and Sariaya and Lucena City in Quezon are affected by Storm Surge, 295 ha for Alert Level 1 and 4, 276 ha for Alert Level 4 in the cluster due its geographical location. Only a small area is affected by this hazard, same with tsunamis (126 ha).

San Pablo City, Candelaria, Dolores, Lucban, Lucena City, Sariaya, Tayabas City and Tiaong have varying susceptibility to lahar and pyroclastic flow, with the city of Tayabas as the most susceptible (2, 706 hectares with high lahar susceptibility).

5.2 Bioecological Profile

Two protected landscapes and one forest reserve are located within the cluster, namely Mt Banahaw – San Cristobal Protected Landscape (MBSCPL), Quezon Protected Landscape and Mt. Malarayat Forest Reserve (MMFR), and Tayabas Bay. From the MMFR, a floral biodiversity assessment found that there are 75 families and 260 species in the reserve with the most dominant family as Moraceae. On the other hand, based on published literature, Mt. Banahaw-San Cristobal Protected Landscape has about 65 families and 178 species, with Family Hymenophyllacea as the most dominant family.

Due to the limited faunal study of MMFR, majority of Cluster 2's terrestrial fauna diversity data came from Mt. Banahaw-San Cristobal Protected Landscape. Around 59 families were listed, with Family Muridae or the Rodent Family as the most dominant with 13 species followed by the Pteropodidae or the flying foxes or Old World Fruit Bats with 12 species.

Under Conservation Areas and Other Special Interest Areas, Quezon Protected Landscape and Mt. Banahaw-San Cristobal Protected Landscape are listed. These Protected Landscapes were identified as a Key Biodiversity Area, Protected Area and currently Ecotourism sites. Moreover, lthere are six caves located in Tayabas City. Also, there are six inland wetlands namely Sampaloc Lake and Lake Bunot in Laguna, and Dagat Dagatan Lake, Lake Pagatan, Ticub Lake and Gunao Lake in Quezon Province.

Furthermore, there are six (6) registered CBFMA holders in the provinces of Quezon and Batangas.

5.3 Demographic Profile

Cluster 2 is composed of three (3) provinces, 18 municipalities, four (4) cities and 662 barangays, and has an estimated population of 1, 345, 340 for its Principal River Basins based on the 2015 PSA Census. The most populated areas within the cluster are San Pablo City, Laguna (261, 576 or 82% of the total population of Laguna) and Lucena City with a total population of 235, 184.

Using a medium assumption from 2010 – 2015, the average life expectancy for males in Cluster 2 is 61 years, on the other hand, females are assumed to live until 75 years. In terms of marital status, majority of citizens in Batangas, Laguna and Quezon Province are recorded as single. Moreover, Cluster 2 has an age distribution with higher population clustered in the younger ages. In terms of gender distribution, the area is characterized by an almost 1:1 male-female ratio. The average household size in the Principal River Basins ranges from 4.0 – 4.5.

5.4 Socio-economic Profile

5.1.8 Settlement Pattern

From 2007 – 2010, it was noted that the urban population from the three provinces increased while the rural population decreased from 3, 875, 736 to 3, 733, 449 for rural and from 2, 467, 629 to 3, 046, 975 for urban. Moreover, the province of Laguna had the highest increase in the urban population from 2007 – 2010. Also, it is projected that the provinces of Laguna and Batangas are soon to be made into industrial provinces while the province of Quezon as an agricultural zone causing an increase from rural to urban population within the cluster river basin.

5.1.9 House Tenure

In Cluster 2 Principal River Basins, 58% (284, 547 people) of the population own their house and lot, 11% (55, 010 people) are renting both house/room and lot and 20% (100, 043 people) own their houses and rent-free lot with the consent of the owner.

5.1.10 Energy Consumption

Most of the households in the Principal River Basins use electricity as source of fuel for lighting (114, 904 households). According to the Philippine Statistics Authority, other sources of fuel for lighting are kerosene/ gas (3% or 3, 930 households), solar lamp (1% or 628 households) etc. for 2015.

5.1.11 Health

In Region IV-A, the leading cause of morbidity in 2015 is Acute Respiratory Infection with around 489, 597 reported cases or a rate of 3, 325.04 per 100, 000 population. In terms of infant death, the province of Laguna recorded the highest mortality rate with 13.17 or 194 infant deaths in 2015 while Batangas has 79 deaths or a rate of 2.59 and Quezon with 107 infant deaths or a rate of 7.11. For the cluster, the provinces of Batangas, Laguna and Quezon have an average of 92.15% of households that have access to safe water supply, with majority under the Level 3 water supply.

5.1.12 Literacy and Education

For the provinces of Batangas, Laguna and Quezon, the average literacy rate for both genders are 99.4%, 99.6% and 99.1%, respectively (PSA, 2015). The percent literacy rate of the municipalities and cities within was observed be 99 percent literacy rate.

5.1.13 Poverty and Subsidence

The province with the lowest annual per capita poverty threshold is Quezon with Php 20, 515 in 2015. On the other hand, the province of Batangas recorded the highest with Php 22, 121 and Laguna with Php 21, 770 annual per capita poverty thresholds. For the municipalities and cities included in Cluster 2, the poverty incidence in 2012 ranges from 2.1 to 37.3 with the municipality of Alaminos having the lowest (2.1) and the municipality of Atimonan as the highest with 37.3.

5.1.14 Human Development Index

In general, the HDI of the provinces within Cluster 2 is high with the Province of Laguna having 0.72, followed by Batangas with 0.67 and Quezon with 0.54. A generally decreasing HDI trend was observed from 2006-2012 for most of the provinces in the river basin.

5.1.15 Employment and Labor

In 2016, Region IV-A recorded an employment rate of 92.8% but the labor force participation rate was recorded to be only 64.2%. On the other hand, unemployment rate was recorded to be 7.2% and underemployment rate at 7.6%

5.1.16 Natural Resource Dependent Livelihood

Historically the provinces of Batangas, Laguna and Quezon are known producers of rice and corn. From the three provinces, Quezon Province produced the most rice and corn from 2007 – 2017 followed by Laguna for rice production and Batangas for corn. It was observed that during 2015 – 2017 there was an increase in both rice and corn production from Quezon Province. On the other hand, for both rice and corn, Laguna and Batangas produced a steady supply throughout the years.

Among the livestock animals in the area are Carabao, Cattle and Goat. In 2018, the province of Batangas had the largest inventory of cattle and goat while the Province of Quezon recorded the highest number of carabaos.

Forestry production in the provinces of Batangas, Laguna and Quezon in 2015 to 2017 included logs and lumbers. Highest production among the three periods was recorded in 2015 with 6, 179 m3 in Laguna, while the lowest was in 2015 with only 3 m3 in Batangas.

5.5 Infrastructure

5.1.17 Educational Facilities

There is a total of 343 educational facilities recorded for the provinces of Batangas, Laguna and Quezon with 287 offering elementary schools and 56 secondary schools for school year 2014 -2015.

5.1.18 Health Facilities

There are 41 government hospitals found in Cluster 2. In the Principal River Basins level, seven (7) government hospitals were identified. These are Mahal na Virgen Maria Sto. Rosario District Hospital, San Juan District Hospital, Lipa City District Hospital, Ospital ng Lipa, Laguna Provincial Hospital - San Pablo City District Hospital, San Pablo City General Hospital and Quezon Medical Center.

5.1.19 Evacuation Centers

There are 270 recorded evacuation centers within the municipalities and cities of Cluster 2. The province of Batangas has 71 recorded centers with the municipality of Sto. Tomas as the most centers with 22 followed by Padre Garcia. For the province of Laguna, there was a recorded 81 evacuation centers with most of the centers found in Nagcarlan (40 centers). Lastly, for Quezon Province, there was a recorded 115 centers with the most recorded found in Candelaria (54 centers). Majority of these evacuation centers are public schools, barangay halls and multipurpose buildings.

5.1.20 Road and Bridges

Majority of the national roads in the cluster are paved asphalt (213, 410 km) and paved concrete with 68, 579 with a total of 281, 989 km of roads found. In terms of surface type and condition of the national roads, majority have a good to fair condition for both concrete and asphalt. On the other hand, there are 79 bridges with 15 located in Batangas, 10 in Laguna and 53 in Quezon.

5.1.21 Water Supply

For the municipalities and cities within Cluster 2 PRB, majority of the households source their water supply for drinking from their own use faucet from the community water system with an estimated of 235, 087 households. The least commonly used water source for drinking are lakes, rivers, rain and others with only 734. On the

other hand, water supply for cooking within the cluster is commonly sourced from their own faucet from the community water system with an estimated 282, 328 households while only 430 households were noted to use other means for water supply.

5.1.22 Dam and Irrigation

There is a total of 12 dams located within Cluster 2 Principal River Basins, classified as seven (7) completed and (4) proposed. Majority of the dams are diversion dams which are used to turn the flow of the river to a different direction aside from its natural course. As of December 31, 2017, there are 28 registered irrigation systems in Batangas Province, 16 in Laguna and 63 in Quezon Province.

5.1.23 Waste and Sanitation

The provinces of Batangas and Laguna have the highest number of households with sanitary toilet with an estimated 89.31% households in 2015. On the other hand, the province of Quezon only recorded 84.5% households. According to the DOH FHSIS (2015), the province with the highest percentage of households practicing satisfactory waste disposal is Laguna Province with 82.11%. waste disposal methods. The most common method in the Cluster PRB is picked up by garbage trucks.

5.6 Stakeholder Analysis

Based from the FGDs, there are at least 29 major stakeholders in the Cluster. These stakeholders were grouped into three categories: user groups, mediating groups, and external interest groups. Seven of which are classified as user groups, 14, which are mostly local people within and near the cluster, are placed under mediating groups, and at least seven were identified as external interest groups.

At least 14 motives that cement alliances were identified. Majority of the issues cementing its alliances are natural resources use and conservation, water use, quality and rights, policies and permitting. On the other hand, some sources of conflicts among stakeholders are administrative conflicts, economic conflicts, conflicting resource use, resource access, pollution, and illegal activities

In terms of importance and influence, twelve (12) stakeholders were identified as having both high importance and influence namely, Local Government Units, Business Sectors, Department of Environment and Natural Resources, Water Districts/ Concessionaries, National Power Cooperation, National Water Regulatory Board, National Irrigation Association, Department of Agriculture – Bureau of Soils and Water Management, Protected Area Management Board, Academe, Prime Water in Lucena, and Farmer's associations (depends). On the other hand, five (5) stakeholders were listed as having low importance and influence, namely religious groups, charcoal makers, slash and burn farmers and timber poachers.

5.7 Land Capability

Land capability refers to the inherent capacity of land to support, on a sustained basis, a particular use or a set of uses. The observed land capability zoning output is based on the observed rainfall scenario and is used as a basis for the allocation of lands. Majority of the areas in Cluster 2 is classified under the Production Zones around 109,

097 ha while Protection Zones only have around 51, 865 hectares. Under the Production Zones, Production Buffer comprises 604 ha, Unlimited Production with 89, 757 ha, Agroforest Production with 3, 242 ha and Limited Production with 15, 494 ha. On the other hand, under the Protection Zones, Strict Protection areas comprise 34, 619 ha while Protection Buffer has 17, 246 ha. The 2050 and 2085 land capability zones were also obtained using the rainfall projections obtained from PAGASA. From the observed to 2050, most significant changes in the land capability is the projected change under the Production Zones with an 1, 028 ha increase in Unlimited Production Zones and a decrease in Agroforest Production areas from 3, 242 ha to 2, 220 ha. On the other hand, the projected change from 2050 to 2085 will have the same trend as the observed to 2050 with an increase in Unlimited Production Zones (863 ha) and a decrease in Agroforestry Zone (533 ha).

5.8 Policy and Institutional Assessment

The following policies encompass the management of the river basin and have a goal to improve the quality of life through poverty alleviation, sustainable development, capacity building, disaster risk reduction, and climate change adaptation. These policies include the Sustainable Development Goals (2015-2030), Philippine Development Plan (2011-2016), Sustainable National Action Plan (2009-2019), National Climate Change Action Plan (2011 2028), Philippine Strategy for Sustainable Development (1999), etc.

These frameworks evolved from the water and environment summits and principles such as the Dublin Principle for water scarcity, Earth Summit in 1992, Agenda 21 and the adoption of IWRM by GWP. Its main objective is to promote sustainable development of water resources at all levels and sectors. It further expanded to the Integrated River Basin development and Management (IRBDM), which is the focus of this master planning project.

Various key government agencies from national and subnational levels play crucial roles in river basin management and development. The institutional arrangements of these agencies possess differing relationship in terms of mandates and functions.
Nevertheless, they have pertinent roles to carry out under the components of river basin management and development framework, namely, water resource management, forest ecosystem and biodiversity, wetland management, flood management and institutional development.

To implement these management strategies and as a solution to eliminate the important issues of fragmentation, lack of coordination, inefficiency, overlaps, it is proposed that there must be a coordinating mechanism that would harmonize the initiatives in the river basin. This should be accompanied by a coordinating body to facilitate delivery of goods and services for the stakeholders as well as provide mechanisms for conflict resolution.

5.9 Sensitivity and Exposure Analysis

5.9.1 Landslide

Based on the model analysis conducted, Malaking Ilog PRB has 16, 503.95 ha classified as having high landslide susceptibility, Iyam-Dumacaa PRB has only 5,

349.37 ha while the aggregated area of the minor watersheds have 12, 373.57 ha identified as highly susceptible.

5.9.2 Water Resources

The total domestic and industrial water demand for the clusters' PRB in 2030 was projected to be 194.20 MCM/yr and 45.26 MCM/yr for Malaking Ilog and Iyam-Dumacaa PRBs, respectively. This based on the assumption that water will be mainly sourced from groundwaters for domestic and industrial water demands and surface water as source of agricultural water demand. Furthermore for 2050, the total domestic, municipal, and industrial water demand grew further to 253.87 MCM/yr and 67.45 MCM/yr for Malaking Ilog and Iyam-Dumacaa PRBs, respectively. On the other hand, the agricultural water demand for 2030 is projected to be around 64.9 MCM/yr, 239.4 MCM/yr and 582.1 MCM/yr in Batangas, Laguna and Quezon, respectively.

The water duty will increase to 76.2 MCM/yr, 244.8 MCM/yr and 607.5 MCM/yr for Batangas, Laguna and Quezon, respectively. In as much as the regional development thrust in CALABARZON is more for industrialization, a modest increase of 100 ha for irrigation development each in the three provinces is estimated for 2050. Moreover, it was noted that the domestic, municipal and industrial water demands in the region far exceeds the estimated available groundwater supply domestic in the watershed cluster.

5.9.3 Participatory Risk and Vulnerability Assessment

Risk evaluation for the cluster considered the consequence and likelihood of the climate- related risk events. Five rating scale from negligible risk to extreme risk were used in the assessment of the risk event (ICT Risk Matrix, 2011). Given the likelihood of the risk events and their potential impacts and consequences, typhoons and flooding due to 'habagat' were categorized as an "extreme risk" in Cluster 2, which entails that immediate controls and measures are required to curtail its adverse effects in the area.

6 Implementation Plan

6.1 Vision

A vision statement for each of the Cluster 2 Principal River Basin was crafted during the focus group discussions. It was made in accordance to an integrated river basin management approach. The vision statements for the two principal river basins are as follows:

Malaking Ilog Principal River Basin:

> **"***A well-managed Malaking Ilog watershed that is resilient and sustainable with empowered stakeholders***"**

Iyam-Dumacaa Principal River Basin:

> *"A resilient Iyam-Dumacaa watershed that is sustainable and well-managed by its empowered, responsible, and supportive stakeholders."*

6.2 Mission

The mission statements were likewise crafted during the focus group discussion and was listed by the stakeholders as follows:

Malaking Ilog Principal River Basin:

> **"***To rehabilitate, protect, develop and preserve the watershed's natural resources through concerted effort of stakeholders for future generations.***"**

Iyam-Dumacaa Principal River Basin:

> *"To lessen the impact of disaster risks and climate change through sustainable watershed management and capacity building. "*

6.3 Development Issues and Challenges

There are several issues and challenges identified in the management of the Cluster 2 River Basin during its characterization and vulnerability assessment. However, six major (6) development issues were identified as main problems.

These issues are listed below:

- Water: Poor Water Quality
- Forest Ecosystem and Biodiversity: Decline of Forest Resources
- Wetland: Decline in Fish Production
- Disaster Risk Reduction: Flooding
- Economic: Poverty
- Institutional: Fragmented efforts in Watershed Management

The root causes identified for each of the themes are as follows:

- Water: Environmental Pollution and Depletion of Forest Cover
- Forest Ecosystem and Biodiversity: Unsustainable Land Conversion, Illegal Occupancy, Forest Disturbances and Unsustainable Upland Agriculture
- Wetland: Biodiversity and Habitat Loss due to riverbank erosion, land conversion, destruction of mangroves, natural hazards and natural resources dependent communities and livelihoods
- Disaster Risk Reduction: Increase rainfall, Clogging of drainage systems, sedimentation and siltation of rivers, insufficient drainage capacity and insufficient flood control infrastructure and equipment
- Economic: Reliance on natural resources-based livelihood, low supply of food commodities, low farm income and insufficient livelihood opportunities
- Institutional: insufficient capacity and resources and weak policies and institutions

6.4 Strategies, Measures and PAPs

The proposed strategies, measures and PAPs were determined by selecting key indicators, defining three (3) future scenarios, identifying current PAPs, estimating Reference Case Values of the Key Indicators, estimating gaps and identifying and selecting Preferred Measures and PAPs. These are briefly described below.

6.4.1 Selection of Key Indicators

An indicator is a parameter that characterizes the state of the PRBs in the past, present and future. A reliable key indicator is one that characterizes comprehensively two or more important thematic features of a watershed e.g., forest cover that is a good indicator of biodiversity, health of soil and water, and stability of ecosystems.

In order to facilitate the identification and selection of preferred measures and PAPs, key indicators were chosen from many possible indicators. From a long list of 11 indicators, only a total of 9 shortlisted key indicators were eventually chosen by a panel of experts and researchers who participated in a planning workshop based on a set of criteria. These are comprehensive representation or characterization the state of a watershed, availability of baseline data for the base year (2015), and availability of tools or methods for estimating its values in the future. The key indicators were subsequently used in the evaluation of which measures and PAPs were the most preferred based mainly on how much these measures and PAPs will contribute to the attainment of set targets for each key indicator.

6.4.2 Defining Future Scenarios

Three (3) future scenarios were assumed. The first scenario is the optimistic scenario where there will be high economic growth, low population growth and climate change to worsen as projected by IPCC (2014). The second scenario represents the business as usual (BAU) scenario where the current global conditions are assumed to prevail in the future. The third scenario is the pessimistic scenario where there will be low economic growth, high population growth and climate as projected by IPCC (2014).

6.4.3 Estimation of Reference Case Values of the Key Indicators

The reference case values are the future values of the key indicators (or future state of the watersheds) considering that there are current PAPs being implemented now and

onwards. Through the panel of experts, the reference values of the key indicators were estimated.

6.4.4 Identification and Selection of Preferred Measures and PAPs

After the adjusted targets for each key indicator were determined, potential measures with corresponding PAPs were identified by the panel of experts. The identified measures and PAPs were selected on the basis of how well these measures and PAPs have performed in past projects and programs of the government. Others were based on current state of knowledge on how a specific measure or PAP affects the state of a watershed. Each of the measures were then rated by the panel on how many percentage points each of these measures will likely contribute in attaining the desired targets for each key indicator. It is worth noting that most measures contribute largely to one specific target and in varying degrees contribute to the attainment of the targets for a few other desired targets. A simple algorithm was used to quantify the likely impacts of a measure given certain level of investment. The preferred level of investments for each of the measures were chosen based on minimum investment with the maximum contribution to the attainment of desired targets.

6.4.5 Identified Programs and Projects

Under the six thematic areas are the following proposed programs and projects.

Theme	Key Indicators	Measure	Program and Project
Water Resources	Water Stress Index	Supply-side management	Water Supply Development
		Demand-side management	Water Demand Management
	BOD/DO	Waste management	Water Quality and Waste Management
Forest Ecosystem and Biodiversity	Forest Cover	Adaptive Forest Ecosystem Restoration	A-FORESTORE
Wetland Management	Wetland Area	Wetland Restoration and Protection	Improved Management of Wetland
			Wetland Protection and Restoration
Disaster Risk Reduction	Number of People Exposed to Hazard	Services Improvement	Services Improvement
			Improve Adaptive Capacity
Economic	Poverty Incidence	Enhancement of Value Chain System	Value Chain
Institutional Management	Cross-cutting with the five thematic areas above		Legislative Policy and Institutional
			Participatory Development Program

7 Investment Plan

The investment plan indicates the budgetary requirements of the various programs and projects that were developed under the Climate Change-Responsive Integrated River Basin Management and Development Master Plan for Cluster 2 River Basin, which is composed of Malaking Ilog Principal River Basin and Iyam-Dumacaa Principal River Basin. To pursue the objectives set forth in the Master Plan, five (5) component programs were developed: Forest Ecosystem and Biodiversity Management, Water Resources Management, Wetland Management, Disaster Risk Reduction and Management, and Economic Development. In addition to these five programs are four (4) other projects that are considered crosscutting in nature as they address concerns of more than one program.

The total investment requirement of the Plan over a 15-year period is PHP 4.597 billion. The Forest Ecosystem and Biodiversity Management Thematic Area has the highest funding requirement among the five thematic areas at PHP1.682 billion (37% of total), followed by Disaster Risk Reduction and Management (PHP 1.356 billion or 30% of total), Wetland Management (PHP1.039 billion or 23% of total), Water Resources Management (PHP320.596 million or 7% of total), Crosscutting Projects (PHP140.980 million or 3%), and Economic Development (PHP58.620million or 1% of total).

Table 1. Total Cost of the Programs/Projects for the Climate Change-Responsive Integrated River Basin Management and Development Plan for the Cluster 2 River Basin.

Program and Project	Total
FOREST ECOSYSTEM AND BIODIVERSITY MANAGEMENT	
Measure 1: Adaptive Forest Ecosystem Restoration (A-FORESTORE) Program	
FORESTORE Program	
Project 1: Native Tree Species Restoration	1,103,517,000
Project 2: Traditional Plantations	578,105,100
Subtotal	***1,681,622,100***
Theme Subtotal	***1,681,622,100***
WATER RESOURCES	
Measure 1: Supply side management program	
Water Supply Development Program	
Project 1: Rehabilitation/ Restoration of Existing and Communal Irrigation Systems (NIS & CIS)	1,366,600,000
Project 2: Construction of Additional Communal Irrigation Systems (CIS)	584,400,000
Project 3: Construction of Small-Scale Irrigation Systems	76,300,000
Project 4: Construction of Bulk Water Supply	538,100,000
Project 5: Construction of Rainwater Collectors	58,500,000
Project 6: Installation of deep wells and distribution system	60,200,000
Project 7: Rehabilitation of Existing Systems and Water Supply	64,800,000
Subtotal	***2,748,900,000***
Measure 2: Demand side management Program	
Irrigation Water Management Project	32,500,000
Subtotal	***32,500,000***
Measure 3: Water Quality Monitoring and Waste Management Program	

Program and Project	Total
Project 1: Effective Ecological Waste Management	8,000,000
Project 2: IEC campaign on proper waste segregation and classification	1,095,657
Project 3: Water Quality Monitoring System	51,300,000
Project 4: Installation of centralized/ decentralized treatment plants	5,736,000,000
Project 5: Waste-to-Energy Project	700,000,000
Subtotal	***6,496,395,657***
Theme Subtotal	***9,277,795,657***
WETLAND MANAGEMENT	
Measure 1: Biodiversity Conservation, Management and Protection Program	
Project 1: Biodiversity and Ecological Assessment of Wetland Areas	44,200,000
Project 2: Harmonized Wetland Conservation Strategy	17,500,000
Project 3: Information, Education Campaign	6,000,000
Subtotal	***67,700,000***
Measure 2: Wetland Restoration Program	
Project 1: Personnel for monitoring and protection of existing and actively restored wetland	36,900,000
Project 2: Sustainable funding for existing marine protected areas and establishment of new MPAs	260,300,000
Subtotal	***297,200,000***
Theme Subtotal	***364,900,000***
DISASTER RISK REDUCTION AND MANAGEMENT	
Measure 1: Adaptive Capacity Development Program	
Project 1: Capacity Development	7,600,000
Project 2: Mainstreaming of DRR and CCA in Local Development Plans	15,000,000
Project 3: Livelihood Development	42,900,000
Subtotal	***65,500,000***
Measure 2: Relocation Project	1,289,600,000
Subtotal	***1,289,600,000***
Theme Subtotal	***1,355,100,000***
ECONOMIC DEVELOPMENT	
Measure 3: Value Chain Enhancement Program	
Project 1: Sustainable Tourism Products Enhancement	15,000,000
Project 2: Climate-Resilient Agricultural Project	25,500,000
Project 3: Sustainable Fisheries	25,500,000
Project 4: Establishment and Enhancement of Post-Harvest Facilities	8,200,000
Project 5: Cooperative Development	6,100,000
Project 6: Industry and Enterprise Development	6,100,000
Theme Subtotal	***86,400,000***
CROSSCUTTING PROGRAMS AND PROJECTS	
Institutionalization Program	
Project 1: Creation and Institutionalization of the Cluster 2 River Basin Management Council	7,000,000
Project 2: Establishment of the Cluster 2 River Basin Office	72,000,000
Project 3: Institutionalizing Collaborative and Integrated ENR	1,300,000

Program and Project	Total
Management Project	
Project 4: Result-based Management System Development and MIS development	12,000,000
Project 5: Capacity Development Interventions	5,000,000
Project 6: Payment of Ecosystem Services System	20,000,000
Project 7: Strict Implementation of Zoning Ordinances	4,500,000
Subtotal	***121,800,000***
Watershed Research and Monitoring Program	
Project 1: Comprehensive Natural Resources Assessment and Monitoring	23,200,000
Project 2: Watershed Instrumentation	29,182,880
Project 3: Feasibility Assessment of Cluster 2 River Basin Plan	25,000,000
Subtotal	***77,382,880***
Participatory Development Program	
Project 1: Cluster 2 River Basin Caravan/ Roadshow	12,000,000
Project 2: Gender Equity and Social Inclusion	7,500,000
Project 3: Development of Curricula for DepEd and CHED	20,000,000
Subtotal	***39,500,000***
Theme Subtotal	***238,682,880***
GRAND TOTAL	**13,004,500,637**